Recent activities in Tenerife GRUAN site

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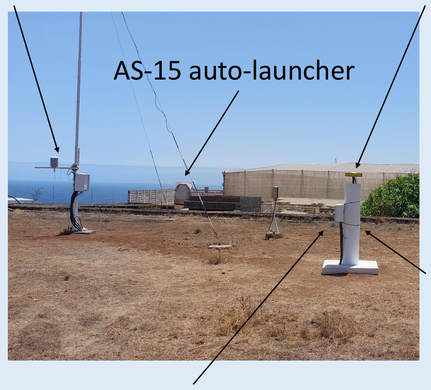
Installation of GNSS equipment (2023)

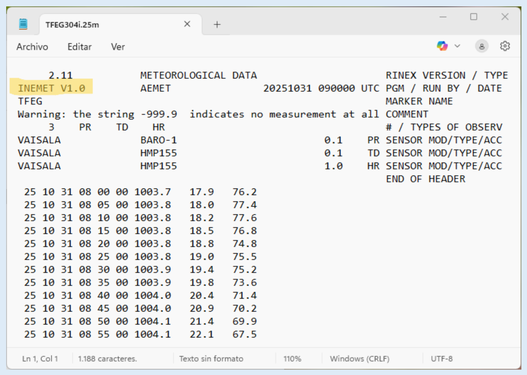
The GNSS antenna installation required to build an adequate monumentation for our soil type characteristics.

Monument for the GNSS antenna was founded on 1m³ of reinforced concrete



GNSS data sharing

- Log files with positioning data are recorded and pushed to ftp server in GFZ directly by DeltaS-3S receiver (using files in native jps format).
- Rinex files with meteorological data are generated by the Vaisala weather station and sent to ftp server using custom software developed by INEMET (thanks to A. Cerezo).



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     2.11           METEOROLOGICAL DATA                     RINEX VERSION / TYPE
INEMET V1.0         AEMET                 20251031 090000 UTC PGM / RUN BY / DATE
TFEG                                                        MARKER NAME
Warning: the string -999.9  indicates no measurement at all COMMENT
     3    PR    TD    HR                                   # / TYPES OF OBSERV
VAISALA             BARO-1                         0.1    PR SENSOR MOD/TYPE/ACC
VAISALA             HMP155                         0.1    TD SENSOR MOD/TYPE/ACC
VAISALA             HMP155                         1.0    HR SENSOR MOD/TYPE/ACC
                                                           END OF HEADER
 25 10 31 08 00 00 1003.7   17.9   76.2
 25 10 31 08 05 00 1003.8   18.0   77.4
 25 10 31 08 10 00 1003.8   18.2   77.6
 25 10 31 08 15 00 1003.8   18.5   76.8
 25 10 31 08 20 00 1003.8   18.8   74.8
 25 10 31 08 25 00 1003.8   19.0   75.5
 25 10 31 08 30 00 1003.9   19.4   75.2
 25 10 31 08 35 00 1003.9   19.8   73.6
 25 10 31 08 40 00 1004.0   20.4   71.4
 25 10 31 08 45 00 1004.0   20.9   70.2
 25 10 31 08 50 00 1004.1   21.4   69.9
 25 10 31 08 55 00 1004.1   22.1   67.5
```

Sample RINEX file with meteorological information generated in the data logger of the Vaisala MAWS 110 weather station.

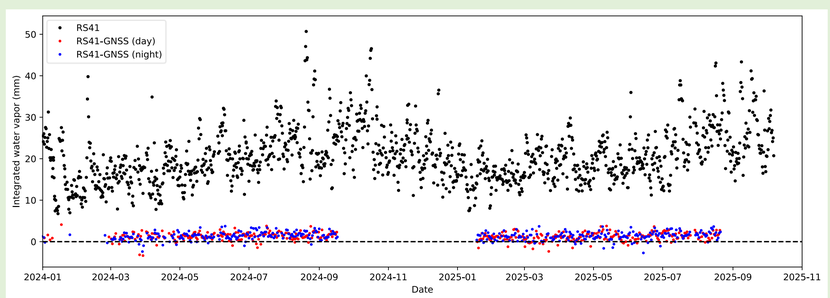
Integrated Water Vapor (IWV)

Comparison of GNSS data with RS41 profiles

We computed the integrated water vapor from the RS41 GRUAN data product as $IWV = \int_0^{P_{sfc}} \frac{MR}{g} dp$, where MR is the mass mixing ratio, and g is the acceleration of gravity.

That was computed using a trapezoid integration function in Python. We compared the resulting values with the GNSS estimation in the first 15 minutes interval after the sonde release. Black points indicate the estimation from RS41 data, and below are the differences (RS41 estimation minus GNSS product) for day time (red) and night time (blue) observations.

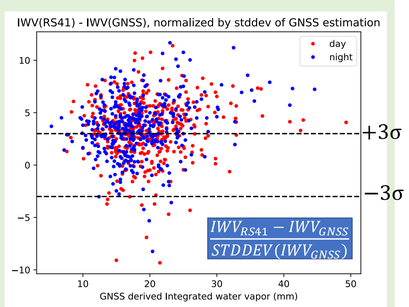
We get slightly higher IWV estimates from our RS41 data (around +**1.3 mm**) compared to the GNSS product.



IWV in the GRUAN GNSS product is provided with an estimate of the error. We normalized the differences between the RS41 and the GNSS values of IWV with this error estimate.

We found that this difference between IWV estimates is in the majority of cases larger than three times the estimated error of the GNSS product:

- Does this mean that the integration from the RS41 data has a much larger error than the one of the GNSS product?
- Or did we use an unaccurate formula to derive IWV from the RS41 profiles?



Calibration laboratory in Santa Cruz de Tenerife

The calibration laboratory for the Tenerife site is located in AEMET's headquarters in Santa Cruz de Tenerife. It is equipped with the following instrumentation: a Vaisala SPS unit; a RI41 ground check, a PC with the *MW41* software; a Vaisala HMP155E temperature probe; and two SHCs, the most recent of including the new adaptor to rotate the RS41 sondes at a 90 degree angle.

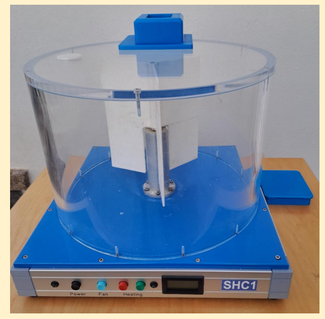
Vaisala HMP155E temperature and humidity probe provided by AEMET national calibration lab. Only the auxiliar temperature probe is used in the SHC.

SPS unit (previously used in the manual sounding station in Santander).

RI41 Ground Check

The auto-launcher in the Tenerife site is 30 Km away from our offices. This makes it difficult to perform an in-situ calibration of the radiosondes before launch. Future operational procedure will include a laboratory SHC test for a subset of the radiosondes before they are transported and loaded into the auto-launcher.

Skills aquired in experiments like the TT4 for auto-launchers have been invaluable to improve our calibration procedures.



First SHC acquired in 2019. Original fan blades broke and were replaced by new pieces produced by local 3D printing company.

Arrangement of available instrumentation in the calibration laboratory.

Second SHC acquired in 2025 with new RS41 adaptor

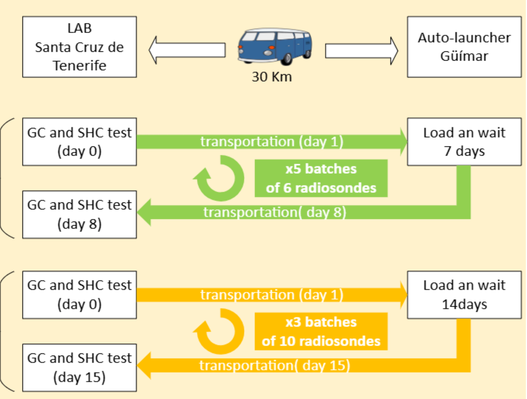
Contribution to TT4 experiment for auto-launchers

- **2021**

Payerne, Tenerife and Hong-Kong (all using Vaisala AS15 auto-launchers) participated in a preliminary experiment aimed to harmonize a manufacturer independent ground check procedure for sites with auto-launchers. Although our results showed large systematic errors, it helped us to discover biases in our operating procedures with the SHC, such as using an inadequate temperature probe for continuous operation in a saturated environment, and to determine optimal heating-cooling cycles in the SHC.

- **2025**

In the TT4 experiment, new sites joined: Potenza, Tateno, La Réunion, and the Modem headquarters. The objective was to account for the different auto-launcher systems within GRUAN and to evaluate the impact of radiosonde residence times on these systems. With the replacement of the temperature probe and the acquisition of a new SHC equipped with the latest RS41 adaptor, we are confident that we can contribute with valuable data to this experiment!



Schematic representation of the TT4 experiment sequence for the Tenerife site. Due to the distance between the calibration laboratory and the auto-launcher, our experiment includes transportation from the lab to the auto-launcher.